

**Before the  
FEDERAL COMMUNICATIONS COMMISSION  
WASHINGTON, DC 20554**

In the Matter of	)	
	)	
LightSquared Subsidiary LLC	)	
Request for Modification of Authority	)	File No. SAT-MOD-20101118-00239
For an Ancillary Terrestrial Component	)	
	)	
LightSquared Technical Working	)	IB Docket No. 11-109
Group Report	)	
To: The Commission		

**COMMENTS OF  
ROCKWELL COLLINS, INC.**

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In response to the Federal Communications Commission's ("FCC's") or ("Commission's") request for comments on June 30, 2011, *Public Notice*,<sup>1</sup> in the above-referenced docket on the Technical Working Group ("TWG") report<sup>2</sup> and LightSquared Subsidiary LLC's ("LightSquared's") proposed recommendations in response to the report, Rockwell Collins, Inc. ("Rockwell Collins") is pleased to submit the following information.

**I. INTRODUCTION AND SUMMARY.**

Rockwell Collins is an industry leader in providing communications and aviation electronics solutions, including GPS, to both commercial aviation customers and the U.S.

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<sup>1</sup> Comment Deadlines Established Regarding the LightSquared Technical Working Group Report, *Public Notice*, IB Docket No. 11-109, DA 11-1133, rel. June 30, 2011. The *Public Notice* sought comment by July 30, 2011, which falls on a Saturday. Under 47 C.F.R. §§ 1.4(e) and (j), when a comment date falls on a Saturday, a submission may be timely made on the next business day, in this case, August 1, 2011. These comments, therefore, are timely filed.

<sup>2</sup> Final Report: 6/30/2011 (the "TWG Final Report"). The TWG Final Report is available in IB Docket No. 11-109.

Department of Defense (“DoD”). As explained below, additional testing of LightSquared’s plan must be required and more information needs to be provided about LightSquared’s long-term deployment plans. As currently proposed in LightSquared’s recommendation, LightSquared’s deployment plan fundamentally conflicts with GPS. Furthermore, the International Bureau’s granting of a conditional waiver of the integrated service rule conflicts with the FCC’s historical policies and procedures regarding the Mobile Satellite Service (“MSS”), and would negatively impact GPS operations in the adjacent spectrum if LightSquared is allowed to utilize the spectrum as envisioned.

Rockwell Collins has the utmost interest in spectral efficiency and is committed to working with both the FCC and industry working groups for resolution of potential interference issues. As such, Rockwell Collins has participated in the Aviation sub-group of the TWG convened by the International Bureau<sup>3</sup> and the RTCA Special Committee (“SC-159”), Working Group 6.<sup>4</sup>

Rockwell Collins was the first company to successfully track the GPS signal in space, and has participated in GPS development activities in conjunction with the DoD and Federal Aviation Administration (“FAA”) for over three decades. Rockwell Collins is a leading supplier of GPS avionics solutions for commercial air transport with our GPS4000S, Global Landing Unit (“GLU”), and Global Navigation Landing Unit (“GNLU”) product lines. In addition, Rockwell Collins supplies military selective availability anti-spoofing module (“SAASM”) GPS to a broad

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<sup>3</sup> See LightSquared Subsidiary LLC, Request for Modification of its Authority for an Ancillary Terrestrial Component, SAT-MOD-20101118-00239, DA 11-133 (Jan. 26, 2011).

range of airborne, maritime, ground-mobile, and weapon system providers, with over one million military GPS receivers delivered and deployed throughout the world.

These products, in conjunction with those of our competitors, serve as the backbone of global aviation navigation systems and have revolutionized precision approach and landing through augmentation systems, such as the FAA's Wide Area Augmentation System ("WAAS") and the Ground Based Augmentation System ("GBAS"). As a result, general aviation, commercial and military flights today enjoy greater safety, navigation accuracy and integrity than ever before.

## **II. ABROGATION OF THE FCC'S HISTORICAL POLICY ON MSS AND ATC REQUIREMENTS WILL LEAD TO DEGRADATION OF GPS RECEIVERS AND IS INCONSISTENT WITH INTERNATIONAL STANDARDS.**

GPS receivers, for both civil aviation applications and DoD applications, are inherently designed to operate in their anticipated environments and are certified and/or qualified to specifications identified by either the government authorities or those of a particular customer in the case of larger, more complex integrated systems. These government authorities and customers (both in the United States and internationally) have relied on the "spectral zoning" of the MSS band for an element of protection when identifying the out-of-band rejection characteristics associated with approved GPS equipment. This reliance has applied for the certification and/or procurement of equipment, for both civil aviation and military applications.

The Commission's rules define MSS to be: "A radiocommunication service: (1) Between mobile earth stations and one or more space stations, or between space stations used by this

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<sup>4</sup> See RTCA, Inc., *Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations*, DO-327 (June 3, 2011).

service; or (2) Between mobile earth stations by means of one or more space stations.”<sup>5</sup>

According to the January 26, 2011, FCC *Order and Authorization*, “[the] 1525-1559 MHz is domestically and internationally allocated for transmission from satellites to mobile earth stations and 1610-1660.5 MHz for transmission from mobile earth stations to satellites.”<sup>6</sup> Thus, the band adjacent to GPS has historically been assigned for space-to-earth communications.

Beginning in 2003, the FCC first adopted rules providing MSS operators the ability to augment the MSS services with an ancillary terrestrial component (“ATC”).<sup>7</sup> The FCC’s definition of MSS makes it clear that this band is primarily zoned for MSS application augmented with an “ancillary” terrestrial component. This ancillary component was considered as an infill service for geographic regions where the MSS satellite signal may not reach. Such regions are limited in scope and the resultant impact to GPS was limited. In addition, the peak power level allowed under the 2003 *Order* was limited to a value<sup>8</sup> significantly lower than the current FCC authorization to LightSquared of one hundred billion billion ( $10^{20}$ ) times the power of the received minimum standard GPS signal.<sup>9</sup> As shown by extensive evaluation of certified

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<sup>5</sup> 47 C.F.R. § 2.1(c) (2010).

<sup>6</sup> LightSquared Subsidiary LLC, Request for Modification of its Authority for an Ancillary Terrestrial Component, *Order and Authorization*, Int’l Bur. (Jan. 26, 2011).

<sup>7</sup> See FCC Integrated Services Rule, 47 C.F.R. § 25.149(b)(4) (2010). See also Flexibility for Delivery of Communications of Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, 1964-65, ¶ 1 (2003) [hereinafter MSS ATC Order].

<sup>8</sup> MSS ATC Order, *supra* note 7, at ¶ 113.

<sup>9</sup> GPS receiver power is approximately  $10^{-16}$  W. LightSquared’s transmit power is approximately 16,000W EIRP (equal to  $1.6 \times 10^4$  W). Hence, LightSquared’s transmission is more powerful than GPS reception by a factor of approximately  $(1.6 \times 10^4)/(10^{-16})$ . This is greater than  $100 \times 10^9 \times 10^9$ , or (one hundred billion billion).

aviation GPS solutions by the TWG, such a deployment leads to GPS receiver overload and desensitization.

Later in 2003, the FCC stated, “[w]e do not intend, nor will we permit, the terrestrial component to become a stand-alone service.”<sup>10</sup> The FCC further stated, “[w]e intend to authorize ATC *only* as an ancillary service to the provision of the principal service, MSS.”<sup>11</sup> Finally, the FCC’s intent to keep the ATC as truly ancillary was clearly reiterated in 2005:

The purpose of ATC is to enhance MSS coverage, enabling MSS operators to extend service into areas that they were previously unable to serve, such as the interiors of buildings and high-traffic density urban areas. We will not permit MSS/ATC operators to offer ATC-only subscriptions, because ATC systems would then be terrestrial mobile systems separate from their MSS systems.<sup>12</sup>

The FCC went on to state that MSS ATC operators must “control self-interference sufficiently to maintain satellite service.”<sup>13</sup>

The net effect of this historical precedent was to preserve a “quiet” satellite spectrum in and around the GPS frequencies to ensure interoperability and mitigate interference issues. Importantly, a critical component regulating use of the MSS band that historically acted to protect GPS and GPS receivers was the need for the interoperability of the ATC with the space component of systems deployed in this band. Previous MSS operators, in protecting their own satellite-to-earth communications, inherently limited the threat to GPS interference. The RTCA, Inc. (“RTCA”), DoD, and International Civil Aviation Organization (“ICAO”) authorities, in

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<sup>10</sup> MSS ATC Order, *supra* note 7, at 4.

<sup>11</sup> *Id.*

<sup>12</sup> See Flexibility for Delivery of Communications of Mobile Satellite Service Providers in the 2GHz Band, the L-Band, and the 1.6/2.4GHz Band, Memorandum Opinion and Order and Second Order on Reconsideration, 20 FCC Rcd 4616, 4628, ¶ 33 (2005).

<sup>13</sup> *Id.* at 4633, ¶ 46.

generating specifications and standards by which equipment is certified, procured, and deployed, have established firm standards dependent on this regulatory requirement. These standards are reflected in the FAA's Technical Standard Orders ("TSOs"), the ICAO Standards and Recommended Practices ("SARPs"), the DoD's Military Standard Orders ("MSOs") and various product procurement specifications for military GPS equipment used throughout the U.S. Armed Forces. Equipment suppliers, including Rockwell Collins and our competitors, design and manufacture products in compliance with these standards and specifications.

The FCC's conditional waiver of the integrated service rule effectively allows the terrestrial component of the LightSquared signaling scheme to mature from an "ancillary" system to a "primary/co-primary" system. The high density of LightSquared terrestrial deployment, coupled with the high transmit power, will negate the protection that GPS receiver equipment had when operating adjacent to the space-to-earth MSS band.

It is clear that LightSquared's previously planned and now modified proposed network runs contrary to the FCC's historical policies and rulings regarding the use of the MSS band. The combination of higher power and the currently-planned LightSquared base station deployment patterns effectively render the terrestrial component of the network as the primary network. Further, and equally important, the FCC's January 26, 2011, *Order* to relax its integrated service rule results in eliminating the need for LightSquared's wholesale customers to



provide “dual mode” handsets and effectively eliminates the interoperability requirement and LightSquared’s responsibility to control self-interference.<sup>14</sup>

These changes to historical policy have effectively turned the MSS spectrum use into one of primarily ground-based signals, which are incompatible with adjacent GPS spectrum use. LightSquared’s business model allows for its customers to make a conscious choice of not using the satellite component of the network offering, and results in terrestrial-only operation using the MSS frequency spectrum, thus effectively reallocating the primary use of the spectrum from space to ground. Because LightSquared’s conditional waiver results in a fundamental change in FCC policy with respect to MSS and ATC services, the conditional waiver should be rescinded.

### **III. LIGHTSQUARED’S REVISED PLAN IS INCOMPATIBLE WITH GPS AND INTERNATIONAL STANDARDS.**

#### **A. Additional Testing in the Lower 10 MHz is Needed.**

In June, LightSquared put forth a modified deployment plan that concludes that the lower 10 MHz furthest from the GPS spectrum has been determined as generally clear from interference.<sup>15</sup> LightSquared further states that its revised plan does not interfere with 99.5% of the existing GPS receivers. Rockwell Collins has seen no factual evidence supporting the claims of non-interference. None of the existing reports of GPS testing against the LightSquared proposal support moving forward with the now revised plan. In fact, a recent FAA report

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<sup>14</sup> Based on the way LightSquared has evolved its business, it appears that it would not provide the handsets. Those who lease the spectrum from LightSquared will be responsible for the handsets. However, relaxing the integrated service rule allows LightSquared to enable those who lease spectrum from them to support terrestrial only handsets.

<sup>15</sup> Recommendation of LightSquared Subsidiary LLC, IB Docket No. 11-109 (June 30, 2011).

concludes that “LightSquared’s initial operations at the lower 10 MHz channel even at ‘reduced’ power levels would impact the aviation use of high-precision GPS receivers.”<sup>16</sup>

Prior to any FCC authorization moving forward, rigorous evaluation and testing of GPS equipment in the presence of the LightSquared signal is required for the lower 10 MHz. This is especially important due to the multitude of aviation and military GPS equipment that could be impacted by signal interference and the conflict of the lower 10 MHz with international standards.

Conclusions drawn by LightSquared in its June 30, 2011, submission to the FCC are based on testing performed on its proposed modified deployment plan, which assessed performance degradation of a limited number of deployed assets. The commercial aviation and military applications serviced by Rockwell Collins have defined procedures, standards, and practices by which performance is measured and evaluated, and it is critically important to note that those existing standards differ from those used by LightSquared in assessing the impact of their proposed modified deployment plan.

Test standards for aviation and military receivers are designed to measure performance at a fine level of detail using receiver acquisition and tracking data. Assessment of this performance degradation at this level is critical in understanding the receiver capability to meet the accuracy, integrity and continuity necessary to support safety of life operations, provide aircraft guidance, compute targeting data, and meet weapon accuracy requirements.

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<sup>16</sup> FAA Navigation Services, *LightSquared Aviation Impacts 1* (July 12, 2011).

**B. No Viable Filters for GPS Receivers Exist to Mitigate the Problems Caused by the LightSquared Proposal.**

LightSquared's modified deployment plan indicates it will not move forward with the deployment of its network utilizing the upper 10 MHz closest to GPS "until receiving explicit approval from the FCC, acting in consultation with the FAA."<sup>17</sup> However, Rockwell Collins and many in the GPS community are extremely concerned that GPS manufacturers will be left to develop and finance a solution if LightSquared is authorized to later utilize the upper 10 MHz closest to GPS where interference has been clearly demonstrated.<sup>18</sup> In fact, LightSquared stated that "GPS manufacturers must begin the process of improving their equipment by adding the appropriate filtering . . . to reject signals that operate outside the GPS frequencies."<sup>19</sup> Filtering solutions to mitigate interference to GPS receivers hinge on using new filter technology that has not been developed.

No viable filter exists to mitigate the interference issues caused by LightSquared's proposed plan. Further, it is not clear whether a filter could even be engineered to mitigate the interference from LightSquared. The following are just a few of the examples of the items that warrant attention if any such filter would be considered and evaluated: (1) vibration and environmental requirements per the certification and procurement standards, (2) significant loss of desirable GPS signal, and (3) application to various combinations of GPS equipment and installations.

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<sup>17</sup> LightSquared, *supra* note 15, at 25-6.

<sup>18</sup> See Letter from Margaret Jenny, President, RTCA, Inc., to Marlene H. Dortch, Secretary, FCC, dated June 16, 2011 (submitting for the record RTCA, Inc., *Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations* (June 3, 2011)).

<sup>19</sup> LightSquared, *supra* note 15, at 26.

If engineers determine that a filter could be designed, it is expected that it would be too large to be designed into the current civil/military GPS receiver card. As far as the smaller handheld military solutions and embedded modules, this large filter cannot be used at all. In most cases, the filter would likely be larger and heavier than the GPS device itself.

The only location in which this hypothetical filter could possibly be used for the thousands of existing certified GPS civil aviation units is after the antenna and before the receiver (inline with the antenna to receiver cable). It would cost untold millions of dollars to not only design this filter, but also to redesign GPS units to fit such filters. There would be further complications with the limited amount of cockpit space for revised units in the aircraft itself, in addition to TSO, certification and implementation costs and requirements for each unit and each aircraft type.

Retrofit of any such filter into a fleet of aircraft would take approximately 8-10 years,<sup>20</sup> if not longer. This would not only cost manufacturers and operators huge sums of money, but would require an unprecedented commitment of FAA resources to address certification. The cost impact of any retrofits on the existing fleet of aircraft will likely be enormous. It is expected to cost at least in the order of tens of millions of dollars to address redesign and redevelopment efforts across the civil and military receiver trade space, assuming the filtering technology is proven and viable.

LightSquared's proposed modified deployment plan calls for use of the upper 10 MHz in 2014. LightSquared indicates that the interference issue with full deployment may be mitigated

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<sup>20</sup> See TWG, *supra* note 2, at 16, 28.

by a filter that costs as little as five cents.<sup>21</sup> LightSquared supplies no factual data to support that assertion. The fundamental technologies involved in the filters referred to by LightSquared that allow them to be small and low-cost actually prevent their use over the wide temperature range associated with commercial aviation and MIL-Standard temperature ranges. For commercial aviation and military applications in the markets served by Rockwell Collins, again, there is no practical solution that exists today. Further, the testing to date by various groups has shown that LightSquared's use of the upper 10 MHz is incompatible with GPS. Any further order by the FCC should clearly state this conclusion.

**C. International Standards and Necessary Safety Margins for GPS Receiver Design.**

While existing GPS receiver designs accommodate a nominal amount of interference in the adjacent band as governed by FCC and FAA standards and specifications and the ICAO SARPS, the current international standards regulating this equipment do not accommodate the modified deployment plan. LightSquared's proposed modified deployment plan may meet the FAA minimum operational performance standards ("MOPS") for L1 GPS *tracking* for certified equipment per the TSO's that govern GPS navigation. However, international standards call for a factor of four (6 dB) margin for GPS *acquisition*, which cannot be achieved by the modified deployment plan in which the ATC transmits approximately 1.6 kilowatts (32 dBW) of power.

Interference limits were established by the international standards to safeguard GPS receiver acquisition, which is more susceptible to interference than GPS tracking. It is not appropriate to assess degradation based on receiver design margins over and above current certification standards, since different GPS receivers have different design margins. Receiver

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<sup>21</sup> See LightSquared, *supra* note 15, at 18.

design margin also accounts for variability in manufactured equipment and installation. Any analysis of performance degradation must be based on current certification standards. If certification standards had to be changed, developing and harmonizing these new standards would take approximately 8-10 years to account for design, certification of the equipment, etc.<sup>22</sup> In addition, this does not provide any additional benefit to the GPS industry and could potentially result in an overall degradation of GPS receiver performance, which is undesirable when aviation safety is concerned.

While testing performed by the TWG during initial LightSquared evaluation demonstrates, based on a limited number of sample receivers, that vendors may have adequate design margin above and beyond these standards, it is imperative that more comprehensive and rigorous testing of deployed equipment be performed to assess the impact of the proposed modified deployment plan. Any degradation of GPS performance that would be acceptable must be clearly substantiated, given current safety of life considerations, impact to the FAA's Next Generation Air Transportation System ("NextGen") plan for the national airspace, and national security concerns. The FCC should not move forward with any approval that would decrease the current built-in safety margins since doing so will decrease aviation safety and contradicts international standards formulated for the protection of GPS. However, if LightSquared were to move to a different frequency band altogether, these concerns could be eliminated.<sup>23</sup>

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<sup>22</sup> See TWG, *supra* note 2, at 16, 28.

<sup>23</sup> *Id.* at 15-16. "[A] shift in the LightSquared ATC frequency to spectrum that is not adjacent to the GPS band could eliminate all interference concerns for aviation GPS."

#### **IV. CONCLUSION.**

While Rockwell Collins recognizes the benefits of broadband technology, it is critical that further evaluation of the LightSquared proposed modified deployment plan be performed across the spectrum of GPS user equipment categories for DoD and commercial aviation. The TWG evaluation of a handful of aviation receivers with regard to the lower 10 MHz band has been limited to tracking and SBAS message failure characterization and is not sufficient for evaluation of impacts to safety of life and national security applications.

Furthermore, the FCC must continue to preserve the MSS spectrum for primary satellite-to-earth signals in order to maintain compatibility with GPS. Continued incremental degradation of historical FCC policy with respect to MSS spectrum use and integrated service requirements will only result in increased interference and other detrimental spectrum issues.

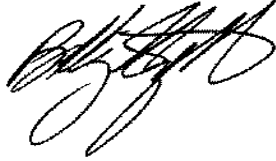
While not raised in the specific comments above, we believe it is also necessary to conduct analytical evaluation of the potential impact of LightSquared's proposed plan on the FAA's NextGen plan for surveillance and control in the national airspace system, including impacts on GPS position and velocity and their use in ADS-B, which will be deployed in the national airspace system. In addition, there has also been very little discussion of the impact of the LightSquared proposal on Galileo and other international satellite systems, and future planned GPS upgrades.

Such shortcomings would be alleviated if the FCC were to pursue a formal rulemaking process, which would include broad and sufficient analytical testing and analysis of LightSquared's proposed modified deployment plan. Given the importance of both GPS and

broadband, the complexity of the issues involved necessitates and deserves a more formal and thorough process than that which has occurred to date.

Respectfully Submitted,

ROCKWELL COLLINS, INC.

A handwritten signature in black ink, appearing to read 'Rob Sturgell', with a stylized flourish at the end.

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